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Supplemental Report on the Effects of a Retrofitted Diffuser on the Discharge Outfall for the Proposed Seawater Desalination Project at Huntington Beach, CA.

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The proposed Seawater Desalination Facility at Huntington Beach, CA would utilize the existing outfall infrastructure at the AES Huntington Beach Generating Station. As presently configured, the offshore infall tower at this facility is fitted with a velocity cap while the discharge tower is not. Consequently, the discharge stream produces a single jet directed vertically upward. All hydrodynamic analysis is based on this existing infrastructure to determine the dilution and dispersion of the concentrated sea salts that would be added to the discharge stream by the proposed desalination facility (Jenkins and Wasyl, 2004). This supplement provides several hydrodynamic model results to examine how dilution and dispersion of these concentrated sea salts might be altered by the addition of a diffuser to the existing discharge tower.

There are perhaps hundreds of diffuser designs used in ocean outfalls, but only a handful would be practical for retrofitting to the existing outfall tower of the AES Huntington Beach Generating Station. These diffuser designs are constrained by the hydraulic design parameters of the existing sea water circulation system, in particular the design pressure gradient along the discharge pipeline. Therefore, multi-ported diffusers that utilize many small diameter diffuser ports would result in too much back-pressure for the existing pipeline and pump configuration to operate efficiently. In addition, the existing discharge tower produces a discharge point about mid-depth in the water column, making the retrofit of a diffuser with lateral discharge arms infeasible from a structural strength and support perspective. The most practical diffuser concept is a velocity cap retrofitted to the discharge tower, identical to the one that already exists on the infall tower. A velocity cap would provide 4 lateral diffuser ports with rectangular cross section, producing 4 horizontal discharge jets. We assume these jets are oriented in the cross-shore and along shore directions, parallel to the walls of the discharge tower.

Figure 1, shows how the bottom salinity distribution would become if the velocity cap diffuser were retrofitted to the *Low-Flow* event scenario in Figure 4.3 of Jenkins and Wasyl, 2004. Figure 2 shows a corresponding result for the average water column salinity with the velocity cap diffuser. Figure 2 would contrast with Figure 4.1 of Jenkins and Wasyl, 2004 for no diffuser. Figure 3 shows the depth-averaged dilution factors with the diffuser that compares with Figure 4.6 of Jenkins and Wasyl, 2004. These comparisons (for what is essentially a worst case scenario) indicate that the velocity cap diffuser would cause faster dilution of the sea salts in the water column beyond 600 ft from the outfall (far-field), but would result in higher salinities on the seafloor within 600 ft from the outfall (near-field). The diffuser eliminates the hyper-saline surface boil and increases the dilution factor at the shoreline from 32 to 1 to 38 to 1. However, these favorable far-field water column effects produced by the diffuser are offset by increased benthic impacts near the outfall. A comparison of Figure 1 with Figure 4.3 of Jenkins and Wasyl, 2004, shows that the diffuser would increase maximum seabed salinity at the base of the outfall from 48.3 ppt to 50.0 ppt for the *Low-Flow* event scenario, and that the benthic area experiencing a 10% increase in salinity or more would increase from 15.6 acres to 24.5 acres. The explanation for higher bottom salinities with the diffuser is that the horizontal diffuser jets permit only the lower ½ of the water column to engage in the dilution volume of the heavy hyper-saline discharge near the outfall. On the other hand, this hyper-saline discharge must subside from the surface boil in the absence of a diffuser, and pass through the full depth of the water column in the immediate neighborhood of the outfall, thereby increasing the near-field dilution.

In conclusion, a diffuser would provide an increased dilution factor at the shoreline. However, a diffuser would increase the seabed salinity within 600 ft of the outfall because only half of the water column would be engaged for dilution and because the present discharge configuration ejects the concentrated seawater away from the seabed. The benthic area would consequently experience higher salinity in the near-field. Therefore, the current outfall configuration allows for a more rapid dilution of the concentrated sea salts.

References:

Jenkins, S. A. and J. Wasyl, 2004, Hydrodynamic modeling of source water make-up and concentrated seawater dilution for the ocean desalination project at the AES Huntington Beach Generating Station, submitted to Poseidon Resources, 298 pp.

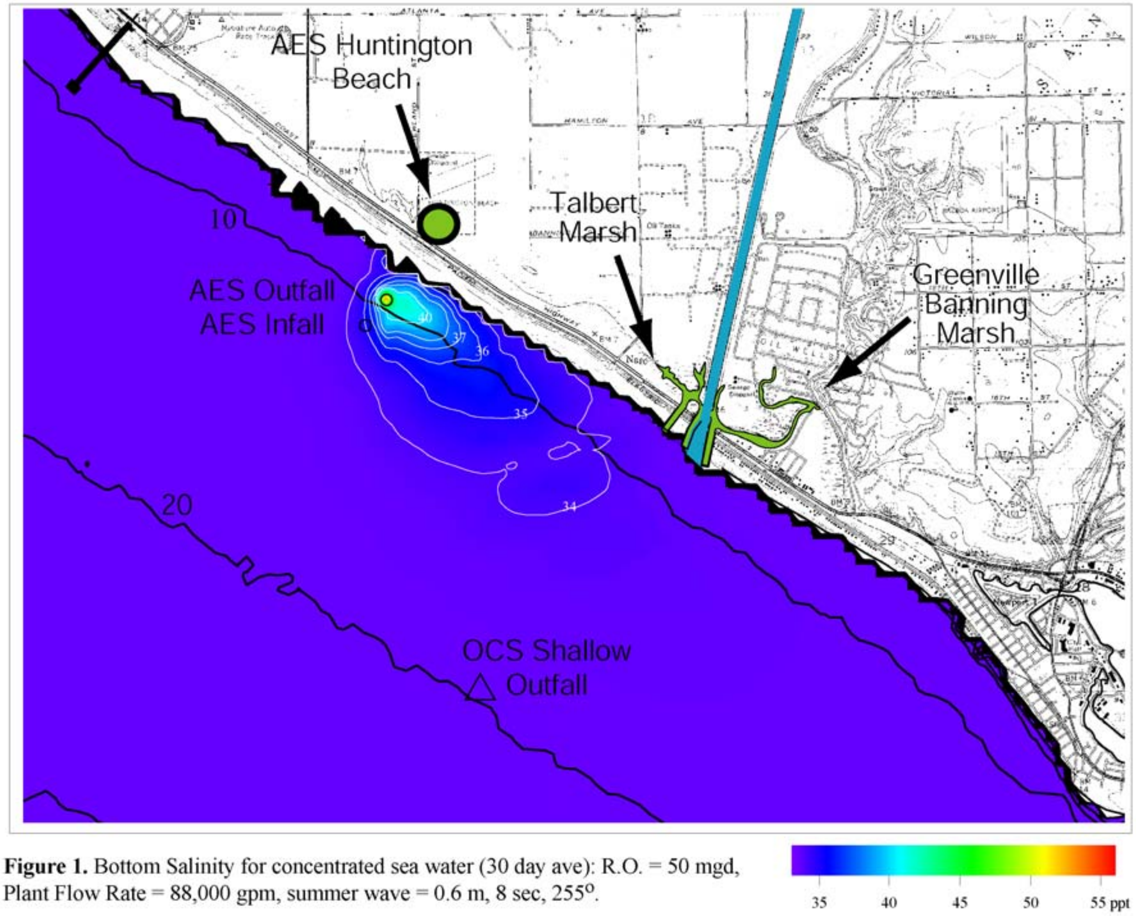

Figure 1. Bottom Salinity for concentrated sea water (30 day ave): R.O. = 50 mgd, Plant Flow Rate = 88,000 gpm, summer wave = 0.6 m, 8 sec, 255°.

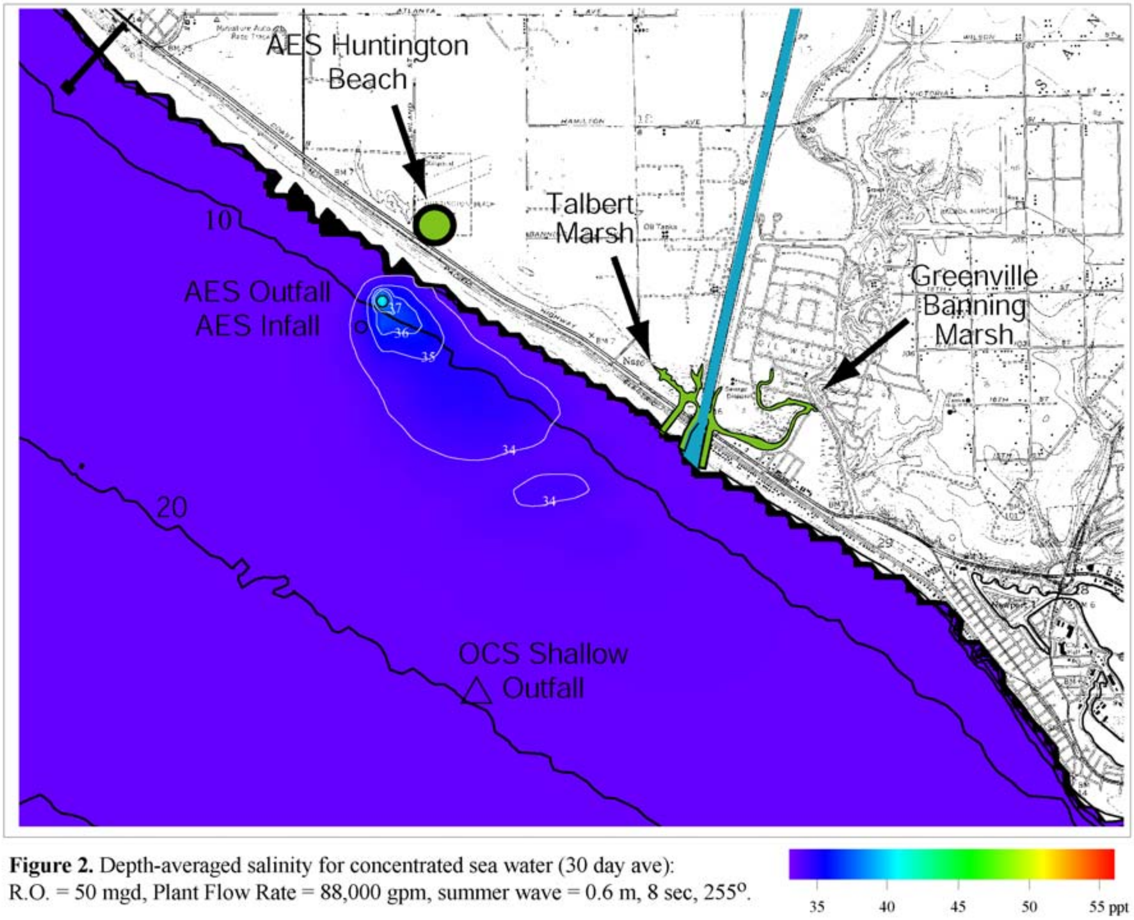

Figure 2. Depth-averaged salinity for concentrated sea water (30 day ave):
R.O. = 50 mgd, Plant Flow Rate = 88,000 gpm, summer wave = 0.6 m, 8 sec, 255°.

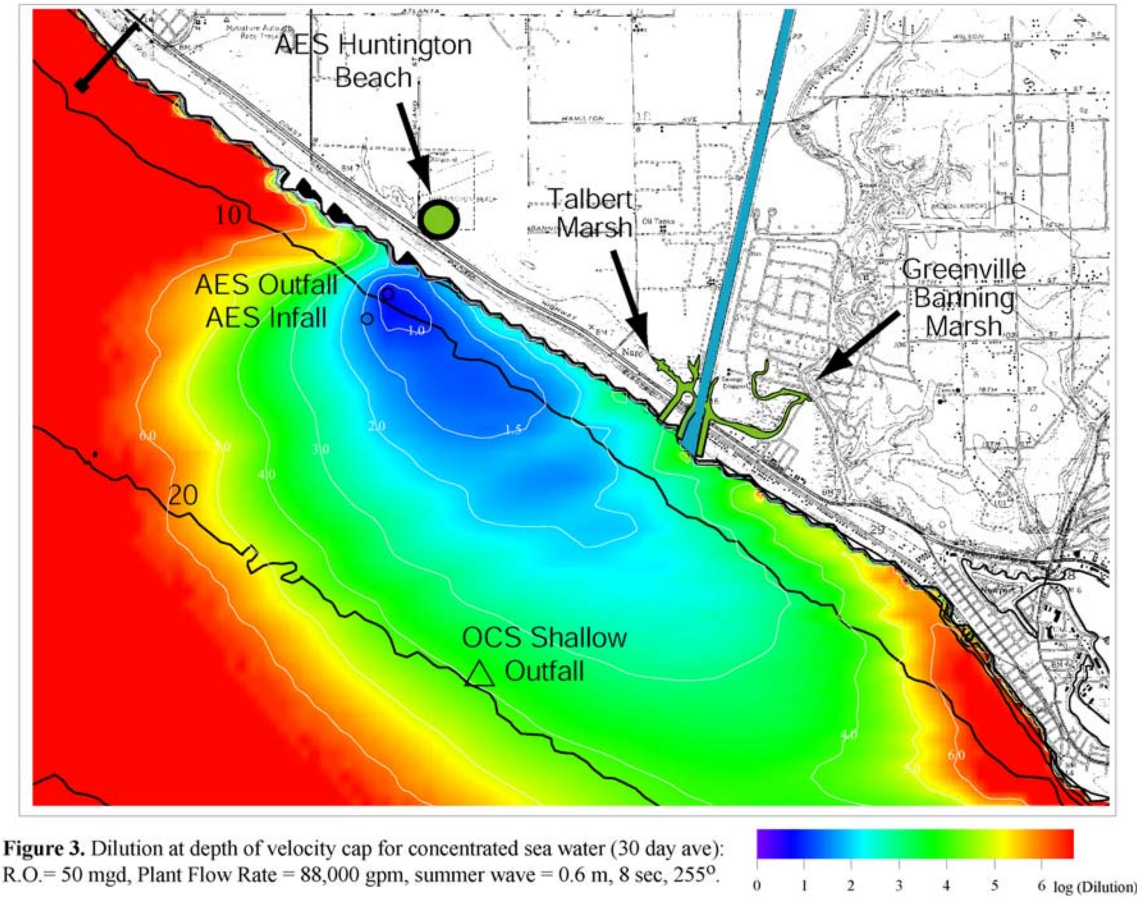

Figure 3. Dilution at depth of velocity cap for concentrated sea water (30 day ave): R.O.= 50 mgd, Plant Flow Rate = 88,000 gpm, summer wave = 0.6 m, 8 sec, 255°.